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ABSTRACT

This study examined whether new streamed Internet audio and video technology could be used for primary instruction in off-campus research classes. Several different off-campus student cohorts at Illinois State university enrolled in both a fall semester qualitative research methods class and a spring semestet quantitative research methods class. Both classes combined asynchronous web-based materials with synchronous audio and video transmissions. Both courses used a combination of Real Media's Real Encoder and Real Player technology (for transmitting the audio and video components of the live class from the instructor to the remote students) and real-time chat and discussion group software (for bi-direction typewritten interaction between the remote students and the instructor). Both courses demonstrated that it was possible to deliver even highly technical research-oriented courses over the Internet using streaming audio and video technologies. However, both courses also encountered several critical problems and issues, such as a sense of disconnection from the group by distance students and added time pressures for instructors. (Contains 18 references.) (Author/DB)

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The Evolution of Qualitative and Quantitative Research Classes when Delivered via Distance Education

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Abstract

The purpose of the study was to document whether new Internet streamed audio and video technology could be used for primary instruction of off-campus research classes. An opportunity for a trial arose early in the summer of 1998 for courses to be held in the fall and spring of that same school year. Several different off-campus student cohorts enrolled in a fall semester qualitative research methods class and a spring semester quantitative research methods classes. Both classes combined asynchronous web-based materials with synchronous audio and video transmissions. Both courses used a combination of Real Media's Real Encoder and Real Player technology (for transmitting the audio and video components of the live class from the instructor to the remote students) and real-time chat and discussion group software (for bi-directional typewritten interaction between the remote students and the instructor). Both courses demonstrated that it was possible to deliver even highly technical, research oriented courses over the Internet using streaming audio and video technologies. However, both courses also encountered several critical problems and issues, from both the instructor's and students' perspectives, that might limit when, and for whom, this means of primary instruction is used.

The Evolution of Qualitative and Quantitative Research Classes When Delivered via Distance Education

Teaching courses away from campus is not a new phenomenon. Over the past few years educators have devised a variety of innovative means to reach remote students unable to attend classes at a central location (Rossman & Rossman, 1995). New technologies have provided additional means by which to reach distant students. Increasing numbers of higher education programs, including graduate-level Masters and Doctoral offerings, have been including these technologies in their education-at-a-distance offerings. Although many of these graduate-level courses are professional rather than research in orientation (Maxwell, 1995), there has been increasing interest in using new technologies for more traditional, research graduate programs of study (Kearsley, 1995).

For the graduate student population e-mail has been (and probably continues to be) the most frequently used, and easiest to master, means of out-of-class communications (Hesser & Kontos, 1995). Other methods of distant teacher-student interaction, including telephone conference calls and electronic libraries (Mizell, 1994), provide content and interaction resources beyond what simple e-mail can muster. Direct audio conferencing has also been used (Burge & Howard, 1993), although the absence of visual cues proved a significant detriment to student interaction. Telecourses, or Interactive TeleVision (ITV) courses, have also been popular and quite successful (Garland & Loranger, 1996; Miller, 1993). Unfortunately, this means of instructional delivery create restrictions on the time and place students must be at to receive the instruction. ITV courses also tend to involve more expensive equipment, higher connection (dedicated line) charges, and a greater degree of technical support.

The increased proliferation of the Internet has seen an exponential growth of new course offerings via computer. Most of these courses have been asynchronous in nature, with neither students nor instructor having a particular day or time requirement for access. Synchronous Internet-based instruction has been much more limited, suffering from the lack of usable software and limited bandwidth. Several programs have been making gradual inroads into this area, providing low cost, Internet-based audio and video conferencing solutions. The most popular of these, CU-SeeMe, had been in use for several years by hobbyists and researchers for point-to-point discussions and multi-point conferences (Schrum, 1995; Barron & Orwig, 1995). Educators have begun to experiment with CU-SeeMe for actual course delivery (Todd, 1996). While Internet-based audio and video conferencing programs like CU-SeeMe have the promise of low cost, ease of operation, and no need for expensive equipment or highly trained technicians at central sites, its performance to date has been plagued by problems and less than perfect operations (Hecht & Schoon, 1998).

In research methods and statistics classes, unlike many qualitative methods courses, computer use has always been an integral part of instruction. More recently, the Internet has provided additional tools: library resources, on-line texts, simulations, web-based calculators and statistics applets/programs. One dilemma an instructor faces in using these tools is to balance how one spends class time and the amount of time students spend on outside of class time. This

is particularly important given recent research on statistics education. The field is encouraging instructors to "(1) state course goals, (2) analyze data and do projects, (3) use computers (for most courses), and (4) lecture less, teach more" (Cobb, 1993). As instructors try to incorporate the constructivist principles and authentic situations described by Willett and Singer (1995), they must think of new ways effectively teaching for distance education.

Two Opportunities

The Department of Educational Administration and Foundations, a graduate-level unit in the College of Education at Illinois State University, has as one of its primary missions the preparation of educational leaders in public schools. Accomplishing this mission often requires teaching courses off campus. Several off-campus cohorts draw students from a central location approximately a three hours drive from campus. The distance from campus makes weekly travel impractical. Intensive, multi-day weekend sessions are sometimes offered, although certain courses (such as qualitative and quantitative research methodology courses), and certain instructors, do not adapt well to this delivery format.

One off-campus cohort is particularly unique. The University has been delivering a doctoral program, through a special contract, to 25 educators in Thailand. For most courses, Illinois State instructors go to Thailand for four weeks to teach. Past experience teaching in Thailand using this model showed that the four-week period was too short to adequately learn the intended research course content. It was thought that the majority of a class would be delivered via distance technology and the remainder would follow the four-week model.

Dedicated-line compressed video is a popular distance education alternative that has been successfully used with other sites. Unfortunately, these locations did not have the facilities for this kind of remote site connection. Neither were facilities available for instructional delivery via satellite. Asynchronous Internet-based (web) instruction has also been used in other subject areas, although there was some concern about teaching master's level, quantitative and qualitative research methodology classes solely asynchronously. Likewise, compressed two-way audio and video over the Internet (using CU-SeeMe or NetMeeting) had been used experimentally, but with only a limited degree of success.

Newer technology offered by Real Media held the promise of synchronous, error-free audio and video transmission, but only in a single direction (from the instructor out to the students). One off-campus cohort was scheduled to take a master's level qualitative research course, while two others were scheduled to take a doctoral level quantitative class. Could this new technology be used for primary instruction for these off-campus groups? An opportunity for a trial arose early in the summer of 1998, for courses to be held in the fall and spring of that same school year.

EAF 415: Qualitative Research in Educational Settings

Methods

Participants

The qualitative course selected for this trial was a Master's level Qualitative Research in Educational Settings course, delivered simultaneously to both an on-campus class and to an off-campus cohort of students in the fall of 1998. The on-campus class consisted of twenty regular students who open-enrolled for this course. The off-campus cohort consisted of twenty students working on programs of study leading to the doctorate with a concentration in the higher education.

Early in the summer university technical staff were consulted about the possibility of conducting part or all of the course synchronously over the Internet. The plan was to use a combination of Real Media's Real Encoder and Real Player technology (for transmitting the audio and video components of the live class from the instructor to the remote students) and O'Reilly's WebBoard real-time chat and discussion group software (for bi-directional typewritten interaction between the remote students and the instructor). Funds were made available for the purchase of the necessary hardware and software at the university. The off-campus cohort students were notified about the specifics of the course (e.g., class scheduling, availability for travel to campus, availability for live instructor meetings at a site near them, and prior experience with computer hardware and software). A special session was scheduled for this off-campus cohort prior to the beginning of the regular semester in order to acquaint them with the necessary computer programs they would be using to participate in the class.

Apparatus

By mid-summer of 1998 the necessary software (Real Player, Real Encoder and Real Server) were purchased and installed at the university. The plan for delivering this course was straightforward. The instructor originated the class from a regular distance education (ITV) classroom located on campus. The section of on-campus students attended this class, live and in-person with the instruction. The students in the off-campus cohort section had the option of either joining the class in real-time (synchronously) over the Internet, or participating in class activities at other times (asynchronously) also over the Internet. The process worked as follows:

(1) A computer in the classroom (the capture computer) contained an Osprey-100 video capture card and a SoundBlaster compatible audio card. Audio and video from the room's various cameras, microphones and other multi-media devices were fed into this computer. The Real Encoder software digitized and compressed this audio and video stream, sending it over the campus network to a server computer. The audio and video was also simultaneously recorded on video tape (in case there was a problem with any of the computers or the Internet, and for later use in creating digital copies of the classes).

(2) A second computer in the instructor's research laboratory (the server computer) was running the Real Server software. This program would receive the digitized and compressed audio and video stream from the capture computer, and would make it available to remote students requesting it via Real Player (via the pnm protocol). This server was also providing basic world wide web (http) and file transfer (ftp) services (using Microsoft's Internet Information Server software), in addition to running O'Reilly's WebBoard real-time chat and discussion group services.

(3) Remote students connected to the class in real time using a web browser (either Netscape's Navigator or Microsoft's Internet Explorer). The web browser would provide most of the basic course content, including access to the web-based WebBoard real-time chat and discussion groups. Viewing the classes required the students to have the Real Player software installed on their computer.

(4) The video tape of each class session was encoded and made available for viewing over the class web site the day after the class session. Off-campus students unable (or not wanting) to participate in the class live could check into the class web page and watch all (or part) of the video of class session. On-campus students could also avail themselves of these videos, in case they missed a class or wanted to review particular material.

The capture computer was a Dell Pentium 166Mhz machine with 64Mb of RAM and 4Gb of hard disk space. This computer was running Windows 95, and was connected to the campus network using a 16Mb token ring card. The server computer was a Dell Pentium-II 400Mhz machine with 196Mb of RAM and 9Gb of Ultra-SCSI hard disk space. This computer was running Windows NT Server (with Service Pack 3) and Internet Information Server (version 4). The server was connected to the network using two high-speed token ring cards: one dedicated for WWW and FTP services, and the other dedicated for Real (pnm) and WebBoard services.

Procedures

The first task facing the instructor was the setup, installation, and testing of the various hardware and software components. Different transmit and receive bandwidths, audio and video CODECs, and connections strategies were experimented with over the course of almost two months of trials during the summer of 1998. While higher data rates could provide larger images, sharper image quality, higher video frame rates and clearer audio, these rates were not always maintainable over the Internet. Tests were conducted both on campus, and at various off-campus sites on different days and at different times of the day.

Several sets of different combinations of CODECs and transmission data rates were enumerated and associated with varying degrees of success under these changing network conditions. Generally, a one-quarter image (120 x 160) in full color, preference given to audio, and a frame rate of approximately 12fps required about 60Kbps bandwidth. However, it was determined that no one setting would work optimally under all conditions; thus, the instructor had to be willing (and able) to change key settings throughout a class as the instructional needs,

and prevailing networking conditions, changed. For the most part live classes were transmitted over the Internet at a 40Kbps data rate, requiring off-campus students who wanted to participate in the live classes to have an ISDN (or faster) Internet connection. Taped classes were encoded at two different data rates: 60Kbps, for a higher quality recording that could be viewed over a dual-ISDN (or faster) connection; and 20Kbps, a lower quality where preference was given to audio that could be viewed over a 28.8 (or faster) modem connection.

During this same time period the instructor was reformatting courseware for this new model of delivery. To facilitate the evaluation of this course the instructor kept a daily diary, recording his observations and experiences. Students were encouraged to e-mail the instructor detailing their impressions, as were the technical staff assisting with the project. Dialogues from each class' chat session, as well as the discussion groups, were maintained for later analysis. These written records, along with the materials developed for and used in the course, were examined as the record of the course activities.

Results

Technology

Overall, the technology worked great! Only once during the fourteen class sessions did the Real Encoder software lock up, and it was easily recovered by simply restarting the program (accomplished in less than one minute). Students occasionally reported the Real Player programs having to rebuffer (pausing the video due to network congestion); however, the video would automatically restart after the congestion had cleared (this is a feature of the Real Player software). Students also occasionally reported the Real Player program locking up. As with the Real Encoder, simply restarting the program and reconnecting to the class feed solved this problem.

Few problems were reported with the WebBoard chat and discussion groups. Although the chat function would provide text transmission relatively quickly, the combination of buffered video technology and individual typing speed would sometimes make this seem, to the students and instructor, like the chat was taking several minutes to work. Out of class tests confirmed, however, that the chat was performing as advertised, and was actually transmitting the entered text relatively quickly (generally in under 15 seconds) between participating computers. No difficulties were reported with the discussion groups other than those associated with learning how to navigate among the various screens. Students previously familiar with Internet discussion groups and list serves adapted quickly and easily to the WebBoard layout, while those with little or no experience required some learning time.

The server computer and software likewise performed as expected. Three times during the semester the server crashed, requiring a reboot. These crashes were attributed, however, to Windows NT issues rather than anything directly connected with the class. The Real Server software provided excellent streaming services, allowing different students to simultaneously watch different videos without problems. A faster Internet connection (e.g., 100Mb Ethernet) would have improved video throughput, although the campus was not wired for anything faster

than 16Mb token ring at the time this class was taught.

Student Issues

On-campus students reported few differences in their perceived kind or quality of instruction when compared to a single section, on-campus only course. Several students spoke of feeling somewhat "disconnected" with the remote group, particularly since they could not see or hear the remote students (the only feedback from the real-time off campus students was the instructor reading the students typed chat comments). One on-campus student went so far as to state "it felt, at times, like [the instructor] was teaching two different classes at once." This feeling was accentuated when the instructor would pause, waiting for a comment or response to be typed into the chat room by an off-campus student.

The on-campus students reported using almost all of the traditional web materials that were available for the course: syllabus, handouts, PowerPoint slide shows, and other graphical items. Few of the on-campus students, however, took the time to go back and watch the video taped classes, and of those they reported only watching parts of certain sessions. One on-campus students stated "it was great to be able to watch the class when I had to miss class [due to illness] – otherwise, though, I didn't really use them because I was in the class the rest of the time." The on-campus students rarely participated in a real-time chat room, primarily since these chat room discussions took place almost always when class was in session (for the purpose of the off-campus students communicating with the instructor).

Approximately one-third of the on-campus students were active on the discussion group, exchanging posts with both on- and off-campus classmates throughout the semester. While all of the on-campus students posted at least one message to the discussion group (it was a requirement of the course), the majority used this medium of communication rarely. When queried, these students responded that they would see each other weekly in person in class, and really didn't need additional interaction with their classmates. Despite this flexibility in scheduling and format, most of the off-campus students indicated that they would have preferred an in-person instructor. When faced with the challenges of distance and common scheduling, these students indicated that this distance format did work for them, although it was not as preferred.

The level of interaction was a key point for the off-campus students. Being able to see and hear the instructor in real-time was critical; however, not being able to verbally ask questions or provide verbal input was missed. One student stated "The chat [room] seemed to take forever – [the instructor] would say something, I would have a question, but by the time I typed it in and he got he would be on to another thing." Faster chat response times, or a means to communicate by directly by voice, would be improvements over the system that was used. Off-campus students who participated asynchronously tended not to report this issue, although those students were concerned about how their questions would get addressed through the discussion group. These students reported that the discussion group discussions tended to be about different issues than the questions they would have about things that were covered in class. E-mail to the instructor seemed to be the primary way that this group of students would address their

questions.

Many of the off-campus students, on the other hand, reported liking the flexibility that the course format provided them. Almost half of the students made a point to fully participate in each and every class live yet remotely, while a few others would only participate in portions of the live classes (watching the remainder later in the week). Several students were unable, either due to professional obligations or technical limitations, to connect to the classes live, and would watch the class sessions at other times.

The off-campus students reported utilizing the web materials as much, if not more so, than their on-campus counterparts. These students reported frequently accessing class related web content while the live class was going on, of while watching a video tape of a prior class session. This was probably due, to a large part, on the low resolution of graphical web content when converted to video, digitized, and compressed for Real Player transmission as compared to the same material viewed directly in a browser. The off-campus students also reported, not surprisingly, being unable to "touch and feel" some of the example items the instructor brought into class for the on-campus students to use. They had to rely entirely on the video and audio being transmitted, and on the content the instructor had put up on the web pages.

Those off-campus students who participated in the live classes heavily used the real-time chat. Approximately half of the chatting were comments and questions directed at the instructor, while the other half were exchanges between students at different locations. At first these exchanges bothered the instructor, who initially felt that this was akin to students talking during a lecture. Over time, however, it became clear that these exchanges were not different that the types of interactions the on-campus students were having, although at more socially appropriate moments in the flow of the class. The off-campus students, perhaps feeling somewhat more liberated due to their geographic isolation, were more relaxed about chatting with each other throughout the class sessions. An analysis of this chat showed most of the interaction to be related to the content being covered in class, with less than 20% on other topics.

All of the off-campus students made good use of the discussion group, with several of the students emerging as very frequent writers. It was not unusual for these off-campus students to write new postings several times each week, expanding on the thread of a discussion already in progress or starting a new thread. For the most part these interchanges concerned themselves with questions and problems the students were having as they worked on their several class projects, rather than topics covered during the class sessions.

A very few of the off-campus students reported not liking this mode of instruction at all. They reported feeling too disconnected from the course and the instructor, and not really in touch with what was going on in the classroom sessions. They felt that participating in a full asynchronous class, one not having taped lectures on line that they were supposed to watch (whether synchronously or asynchronously), would have been an easier and more useful experience.

Instructor Issues

Time turned out to be the biggest issue for the instructor. An enormous amount of time was spent to create instructional materials that would be suited to three different modes of delivery (live and in-person, live and at a distance, and asynchronously). The instructor also found himself spending large amounts of time interacting with both groups of students out of regular class time using e-mail, the discussion group, and over the telephone.

Originally this course had been prepared for presentation in a traditional format: live with the students in front of the instructor. Many items had been made available on the web (e.g., the course syllabus, assignment handouts, and several ancillary links). Providing for the off-campus students required, however, that two kinds of additional work be performed.

The first kind of additional work required developing skills in encoding and serving video tapes of class sessions using Real Encoder, Real Server and Real Player. In addition to the live presentations of the class, the video tapes of the class sessions had to each be encoded and made available on the web. A graduate assistant helped with this process following each class session; however, it required almost an additional eight hours beyond the normal class time for these materials to be created. Other videos were also made available for off-campus viewing, and these also required additional time to digitize, encode, and place on the web server. At one point the instructor was convinced he was operating a professional video editing suite, or web graphics development studio, rather than teaching a class!

The second kind of additional work related to the added time the instructor spent interacting with both the off-campus and on-campus students out of regular class time. It was not unusual for the instructor to receive over 30 pieces of e-mail on any given day connected with this course. Many of these mailings could be addressed with a simple, few sentence reply. None the less, it would require upwards of an hour each day just for the instructor to stay current with the e-mail. The discussion group was likewise time consuming. Although the instructor generally did not involve himself in the ongoing discussions, he made a point to check in with the group each and every day so as to stay up with whatever the students were discussing. A few times each week he would interject a comment into an on-going thread; mostly, though, he would just read what the students were discussing in order to bring any concerns (or need for clarification) back into the next class.

In addition, the instructor added several programmed elements to the class web page throughout the semester. Most notable among these were an interactive on-line grades database, where students could check their progress on assignments after entering a unique username and password, and a on-line final examination, where students could enter the textual answers to exam questions right into a web-based form. Creating these items required the instructor to use Microsoft's FrontPage and to write program code for Active Server Pages (ASP) managed by the web server (in both JavaScript and VisualBasic). These additional items enhanced the functionality of the class, but at a significant cost in time to the instructor.

EAF 509: Research Design in Education I

Methods

Participants

The course selected for this trial was a doctoral-level research design and statistics class, Research Design in Education. Students enrolled in one of two sections: a section reserved for a cohort from Thailand or a section reserved for a cohort from an off-campus site three hours from Illinois State University. The Thai cohort enrolled 25 doctoral students from around the country who all had Internet access from school or home, Windows 95/98 computers, and SPSS software. Internet access was intermittent due to power, weather, or traffic problems. The Illinois cohort class enrolled 14 doctoral students who were full-time educators in Illinois and Iowa. The majority lived within one hour of the distance education site, but five commuted over two hours to attend class. The majority had Internet access from their schools, and most had access from home from a local Internet Service Provider (ISP) or America On-Line (AOL). Students used both Windows and Macintosh platforms and purchased the Studentware version of SPSS (for Macs or Windows).

The original plan for the Thai cohort was to provide weekly synchronous classes over the Internet. A combination of Real Player and Multichat (from Multisoft, Inc.) were used for transmitting audio and video as well as real-time chat between students and instructor. In addition, for students who could not log on during the synchronous sessions, all classes were encoded and archived at both 28.8 and 56 kbps speeds. This plan is still in force, as this course is continuing through the current semester.

The original plan for the Illinois cohort was to provide a choice of delivery modes. Interactive television (ITV), using point-to-point compressed video delivered to the off-campus site, was the first choice of these students. A technician would be present at the remote site, and this person would work all of the controls and record the class to videotape. Students merely had to attend and interact with the instructor. The second simultaneous delivery system was the Real Player and Multichat combination used by the Thai cohort. Students who could not, or who chose not to, travel to the ITV distance education site could choose to log on the Internet and participate in class synchronously along with the Thai cohort.

Thus it was originally intended that, like for the qualitative research course, these two sections would be taught at the same time. This plan did not work. Problems with the ITV distance education site have prevented it from coming on line. In addition, student attitude and technical ability made the second option likewise non-viable. Instead, a traditional in-person class has been offered to this cohort, supplemented with numerous web resources.

Training was provided prior to the beginning of the classes to prepare the students. The Thai students had taken the prerequisite course the previous semester. The prerequisite course

used a combination of asynchronous web-based instruction in addition to a site visit to Thailand by the instructor. During the site visit that completed the first course, instruction on SPSS, Real Player, and the chat (Multichat) program was given to prepare for the Research Design class. The Illinois cohort had attended five non-credit review sessions covering the prerequisite material as well as the Internet-based applications during the previous summer and fall semesters.

Apparatus

The same software and hardware components described in the qualitative apparatus section were used in the research design class. Since the beginning of the spring 1999 semester, the Real Player and Server software has been upgraded to the G2 version that allows the transmission of multiple streams at various bit rates to adjust to users' capabilities. A second change from the fall qualitative class was in the type of chat software used. Instead of O'Reilly's WebBoard, Multisoft's Multichat was used. The instructor purchased a copy of Multichat Pro that offered several features: no advertising, guaranteed connections for 25 simultaneous users, advanced administrator moderation, chat room touring enabling the administrator to specify web sites/pages to be viewed simultaneously by all, and password security.

Procedures

The instructor benefited from the previous work accomplished in the qualitative course. The technical specifications, hardware, and software for transmitting the class via the Internet were already piloted and tested. However, the ITV option for the class was not operational when the course began. Although the distance education site was supposed to be working by the fall 1998 semester, as of this date, the off-campus site has not been able to connect to Illinois State. Once the Illinois cohort was informed that the ITV option was not available and only the Internet transmission was feasible, the cohort met and contacted the Department chair voicing their concerns and problems. After meeting with the Department chair, the instructor agreed to teach this group in person rather than use the Internet as the primary means of delivery. For this cohort, the Internet and Real Player options were used when students could not attend the live class.

As the course has progressed, the instructor has kept notes and collected all email correspondence from students. At the end of the semester, students will be asked to evaluate the various synchronous and asynchronous components of the class.

Results

Technology

In moving from on-site classes to distance education classes, the instructor had to resolve numerous technical issues. Below is an ordered list of technical problems:

- Lack of compatibility between two distance education sites

- ISP, modem, and computer problems
- Upgrade, access, and download issues

The major problem this semester has been the lack of compatibility between the two distance education sites. For over a year the instructor worked with the distance learning site to assure that the equipment would work and that training for faculty and students would be available. At this point, the videoconferencing equipment at the distance education site cannot connect to Illinois State. Although conflicting information has been provided, one recurring theme is the apparent lack of compatibility between providers for the Illinois State (GTE) and the distance education site (Ameritech).

A second set of problems has emerged for the Internet delivery of the course. For some students, everything worked well from home or school. However, for other students, network congestion problems prevent smooth streaming of the class videos. One student wrote, "This is really frustrating after having Real Player working well the last time I was in it and then having an entire day to access it and not being able to get in!" So far, the students who have noted problems have been mainly AOL or Macintosh users. Additional problems such as blank screens, "hang-ups," and lack of audio appeared for students who have low-end computers with the minimal requirements noted by Real Media. For the Thai students, the Internet problems appear to be related to power outages, weather, and servers that are down. One student wrote, "Sorry I miss the chat. I have a problem with my server in Thailand so I counld (sic) not connect to the net." The instructor tried all the class materials while in Thailand and, when she could access the Internet using a popular ISP (Loxinfo) with a 28.8 baud modem, could use the streamed video and audio files as well as use the chat and other on-line resources.

Because students faced problems with upgrading their browsers or downloading free plug-ins, the instructor created a web page with information on the basic hardware and software needed for class. Many students found keeping up with upgrades and downloading to be a problem with 28.8 baud modems. Even if they upgraded to a 56K modem, some ISPs do not offer higher connectivity rates. With a 28.8 baud modem, streaming took longer to buffer, downloads took a very long time, and the interactive quizzes took longer to process. Another problem occurred for those who worked from schools that had protected sites or firewalls. Students would have to work with either a network manager or school administrator if they wanted to download or use certain software for class from schools.

One solution found to address the Internet problems above has been the creation of a class CD that contains the class material. The instructor took all the class web pages and existing Real Player files and pressed a CD to distribute to students. Using the CD, students could access most internal class links and video without dialing out with a modem. At the mid-semester point, a second CD was distributed that contained the on-line classes broadcast since the first CD was created. The CDs cost only one to two dollars each so the cost to the students is minimal.

Student Issues

Some of the major problems moving to distance education relate to the nature of our students -- non-traditional adult learners returning to school after being out for many years. First, many adult learners do not have the technical skills and "competent" attitudes toward technology that many undergraduates gain as they move through the educational system. Adult students have been out of schools for many years, and their skills have not kept up with technological advances. Second, because they live at a distance, they cannot avail themselves of individualized assistance outside of class assistance as can traditional students. They could, however, use the technical resources added to the course, but they do not use these due to their technical weaknesses. Thus, students expend much more time and effort to learn computing in general as well as the specific statistics concepts and procedures than do students in the traditional classes, but believe they are learning less. Below is an email that characterizes students' feelings at the beginning of the semester:

> I met with [names of classmates deleted] this morning. I sensed quite a bit of frustration there. It's not up to me to talk for others, but I am having trouble trying to do all the labs, videos, and book work that is needed and still do my job. I have spent hours and hours on this class, and I am not sure I get anything concrete accomplished.

Due to the two constraints above, many adult students who are assertive, successful professionals outside of class appear fearful, passive, and helpless in class. One student's spouse has attended all classes and tried all the computer assignments in case the student misses something. The tone of the following message is common: "I am sure the problem is with the techno-peasant me, but I wanted to let you know my clock could still be running." One student wrote a message after reviewing class web pages that reviewed topics covered in required prerequisite course (not the new class material).

> Things aren't impossible right now, but the class hasn't even begun yet and I'm feeling overwhelmed. I know you are working as hard as we are, and I know you want us to succeed. I don't know if I am going to be able to handle all the different demands upon my time. You will notice I haven't even mentioned a family life.

As researchers have noted, training for students and faculty to prepare for distance education is necessary. Recognizing this, to prepare this spring semester's Illinois cohort for the distance education experience, the instructor met with them at their distance site off campus five times during the previous summer and fall semesters. Review sessions lasted three to five hours and included time reviewing the prerequisite material because most students had taken the introductory research class 10 to 20 years before. Lab time in the review sessions including teaching students how to use the web, download files, FTP, search and retrieve texts and articles on line from the library, download and install software, send attachments, etc. Another instructional aid used was to cut-and-paste screen images into the instructions explaining how to complete the steps above. The Thai cohort had recently completed a technology class that required them to access web material, use e-mail, FTP, and create Web pages, so they some technical literacy. However, the cohort tended to work in a group, and some individuals were

lacking some skills. While the instructor was in Thailand, review sessions were held and each individual was asked to demonstrate skills in using the resources for the class that would start in the spring.

Despite this training, many students continue to demonstrate a lack of basic computing knowledge or the ability to transfer basic skills. "We can't figure out how to print out the overheads. What plug-in do we need? Also, how do we print out the power point slides?" Students needed to be shown how to select <File> <Print> from the menu. "I have tried to access the taped lecture. I can barely see the video. Although I have the volume set on high, I cannot hear you at all." This student was shown how to increase the screen size with the magnifying glass icon, and how to increase the volume controls using the Properties command in Windows 95. A continuous series of these minor technical problems have had a cumulative effect of being very frustrating for students.

The combination of the above factors has created time issues. Students contacted the Department chair and noted they could not complete the course during the regular semester due to the added time needed to learn the technology as well as the content. For the Illinois cohort, the course has been extended two semesters. The course continue until July 30th 1999. This extension has relieved some pressure and negative attitudes present early in the semester. One student's e-mail characterizes the nature of the class. "Thank you for your patience. I told you in the beginning that it takes me a long time to catch on, but I never give up." For the Thai cohort, students know that whatever material cannot be translated well over the Internet will be completed at the end of the semester when the instructor will return to Thailand to help students with their research proposals.

Instructor Issues

Four major issues have emerged for the instructor: time, the importance of forces outside of instructor's control, pedagogical questions, and the limits of the instructor. As stated in the qualitative section, time is the crucial issue. The on-line course has taken this instructor more time to prepare, develop, carry out, manage, grade, and refine than any traditional course she had taught. Preparation started over a year ago when the instructor was informed that she would teach two Illinois cohorts for four semesters. Workshops provided by the University, the Central Illinois Higher Education Consortium, the University of Illinois's Faculty Summer Institute, and external sources such as Syllabus Press (http://www.syllabus.com/) were valuable. Learning from faculty who have already tried different delivery systems was useful. The one reason that the synchronous ITV and Real Player transmission was selected was to retain some of the efficiencies of an on-site class; however, even with the synchronous component, the amount of individual e-mail and phone correspondence has been overwhelming. Now instead of teaching three hours a week in person, the instructor teaches three hours a week, maintains a web page, videotapes and encodes classes, manages discussion lists, attempts to keep up with email correspondence, and a downloads assignments from a FTP site. In the short term, this instructional delivery system has not been time or cost effective, although the instructor expects long-term benefits. As an instructor log entry notes early in the semester, "oh, oh. There is so

much work to do. One really needs a semester lead time to prepare it well."

A second major issue is one's reliance on forces outside of the instructor's control -- human and technical. As the courses were being developed and delivered, the instructor needed to work with individuals from Illinois State and other institutions to offer the class. First, one needs to work closely with the server administrator; this instructor was fortunate that this person was the instructor of the other distance class. Most instructors will not have the support or assistance needed for the Internet transmission of audio and video. To offer any distance education at Illinois State, one has to work with the administrators of the Extended University. This was required for scheduling the course, the rooms, the times, or even to contact some of the technical support people. At the distance education site, other technical and administrative support personnel were involved. Librarians from Illinois State and distance sites became crucial to the success of the research requirements for the course. Doctoral students required many library resources, and these personnel found creative solutions to many access problems. Many of the students asked the technical support personnel from their schools or their spouses to communicate technical questions and problems because they themselves could not explain the problem or understand the solution. Finally, the department chair was a crucial person involved in the courses. Luckily, this instructor received positive support and assistance from the chair to pursue Internet-based instruction, and when problems arose, received flexible scheduling options. This may not be the case at most institutions.

The technical outside forces -- server crashes, ISP problems, virus-laden attachments, and compatibility issues -- are the norm. Students were informed to expect the unexpected, and if they could relate problems the instructor was willing to be flexible about dates, assignments, delivery options, and grading issues. Once students knew that the instructor was flexible and would adjust, some of the technical crises became less a problem. Early e-mails labeled "HELP!!!" have evolved to more positive requests: "I've had a very productive week in locating empirical studies for my paper. I'm also eager to take the chapter 5 quiz. I've been trying to access the quiz today and am unable to do so. Please let me know if it is no longer available and I won't keep trying." The instructor has learned to adopt an attitude the Thai cohort taught her. It can be summed up in the phrase "Mai pen rai" (it doesn't matter--life goes on).

The third major instructional issue related to pedagogy. Due to the overwhelming time commitment to creating content for the Internet-based this first time, the instructor has not found the time to create authentic assessments, class activities, and exercises that a geared to on-line delivery. The tendency is to rely too much on lecture because most students chose to watch class at a late time. For Internet classes that use streaming video, it is easy for the instructor to change from being the "sage on the stage" to the "guide on the side." The "guide" portion of the class relates to the out-of-class experiences created for students; however creating good guided activities takes time. Offering both formats has great potential; in fact, by trying to provide multiple ways for students to learn class content (video lectures, narrated PowerPoint slides, demonstrations, on-line chatting, threaded discussion lists, interactive quizzes, computer labs, etc.), the instructor may have overwhelmed students with too many options. In fact, one early e-mail to the class noted that many of the links and materials were optional; use only what was

needed to understand the material. The intent of the instruction was to offer more active learning opportunities; however, many students seem to prefer less activity! The instructor has reduced the number of required activities in realization that the original expectations were unrealistic given the amount of time it has taken students so far to complete assignments.

The last major issue is related to the limits of the instructor. Teaching this course has been a humbling experience. Concepts and topics that have been easy to teach in traditional ways have proved surprisingly difficult using the Internet. Timing and student-teacher interactions have been very different. Keeping up and responding to e-mail has been less than satisfactory. Finding the best way to receive and respond to student's work has been problematic. On the other hand, teaching this course has made the instructor rethink what is important in teaching and learning. The instructor does look forward to teaching the course a second time next semester to see whether some planned modifications reduce some of the problems and increase some of the potential benefits.

Conclusions

> It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way…. (Dickens, 1859, p. 1)

The results from this study are a "Tale of Two Cities." Although three common areas related to technology, students, and instructors were analyzed; little overlapped between the experiences of the qualitative and quantitative instructors. For the qualitative class, few technical difficulties were encountered. However, for the quantitative class, the problems with connecting to the distance education site as well as some of the students' ISP problems demanded modification of course instruction for one class to avoid major student frustration and failure (Hillesheim, 1998).

The student issues differed as well. For the qualitative class, a comparison of the level of interaction and class participation was a major focal point because there was an on-campus and off-campus group taught simultaneously. In essence, the instructor was conducting a traditional and a synchronous Internet-based class at the same time. For the quantitative classes very different student issues emerged because both classes were distance education classes. The most interesting difference in the two classes was in their reaction to distance learning. For the Thai cohort, the Internet extended opportunities for more interactions; otherwise, a challenging course would be taught in four weeks rather than for a full semester. For the Illinois cohort, the course was a major imposition; for all previous courses, instructors traveled three hours to teach the cohort in person. Distance education was removing a service they had come to expect, required them to learn new technology skills, and demanded more time than did other courses. Hillesheim (1998)

listed numerous student characteristics related to barriers in distance learning that matched the personal and situational characteristics of the Illinois cohort. Spending time learning about one's distance education students before teaching the class would benefit instructors.

The instructor issues were more similar -- time. Time spent planning, developing, maintaining updating, and interacting with students must be considered. Because this was the first time both instructors taught using this delivery method, some of the time issues were anticipated. Others who have implemented distance education courses have reported similar findings for both students and faculty (Kroder, Suess, & Sachs, 1998). Additional pedagogical and effectiveness issues have been raised as well. As Zhang (1998) noted "The challenge for distance educators is to set up a cognitively rich learning environment to facilitate the distant students' construction processes" (p. 399). In future attempts more time can be spent in experimenting with different ways of teaching on line once much of the content has been developed. However, the myth that one can create text and video materials once and reuse them over and over should be debunked. Modification, improvement, and experimentation are the norms for most instructors using the Internet.

The evolution from traditional classes to Internet-based distance education research is not linear. Can this new technology be used for primary instruction for these off-campus groups? Yes, but advanced preparation for and consideration of the characteristics of students and faculty involved are critical. It may appear contradictory, but both students and faculty must be the types to be thoroughly prepared, be flexible to change, and be tolerant of ambiguity and uncertainty. In short, to use Internet-based instruction requires risk taking and a serious commitment by both students and instructors.

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